External forcing, acoustic scattering and scalar transport in the wake of a flapping airfoil

Jueves 17 de noviembre, 2022 | 14:00 horas
Sala de Proyectos, Beauchef 851, Edificio Poniente, 4to piso DIMEC

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SUMMARY

Unsteady wake flows associated to streamlined bodies undergoing non-uniform motion have captured the attention since the pioneering works of T. von Kármán and have been considered a key issue in both aircraft design and the propulsion mechanism of insects, birds and fish-like organisms. By introducing controlled disturbances in the flow, these issues can be addressed and the wake can be probed with external signals of wideband frequency content and particular wave-envelopes. In the case of flat plates placed into a uniform fluid stream, the spatially developing wake may become sensitive to external (controlled or not) disturbances/noise, which can in some situations, be amplified by the wake itself developing interesting vortical structures. The underlying non-linearities of the flow make the flat plate wake a good (but difficult) candidate to be excited with almost any arbitrary signal forcing.

In the present talk we will focus the discussion into the unsteady aerodynamics and the wake flow generated by a simple mechanical actuator, a flapping/vibrating rigid flap installed exactly at the trailing edge of a static flat plate. This simple setup aids to understand the physical mechanisms responsible in the propulsion of living beings and in the lift performance of some natural flyers, as the vortical patterns observed in the wake are responsible of the unsteady drag and lift forces. We will also discuss what kind of research tools we need, either being numerical or experimental methods, to track the problem and gather enough digital data to post-process any useful signal explaining the underlying physics of this non-linear unsteady aerodynamic wake flow.

BIO

Rodrigo Hernández is a Professor in the Department of Mechanical Engineering at the University of Chile. Head of the Laboratory LEAF-NL. Ph.D in Physics, MSc. in Physics and Engineering Science, and Mechanical Engineer. His research topics are: Instabilities and turbulence in fluid mechanics and heat transfer, acoustic scattering, anemometry and body-wave interactions.